Remarks

Summary of Examiner's Action

Claim 32 was allowed, and claim 13 was said to be allowable if rewritten in independent form.

The remaining claims are rejected as obvious over Antonidis or Wan or Hsieh on the grounds that each teach DP-PPV having the electroluminescent characteristic. However, the Examiner admits that the references do not disclose the broad teachings of the claimed formulas causing the blue shift in the photoluminescence and/or electroluminescence of the compounds.

The Examiner asserts that the references disclose compounds "having the claimed adjacent substituents and the claimed characteristics". The Examiner contends the references disclose the "required reactants and steps of the process in claim 14". The Examiner also states it would be obvious to select the reactants and conditions from the references to satisfy the limitations of the present claims since "they have been shown to be effective in a similar system and thus would have been expected to provide adequate results" and that there has been "no showing of unexpected results derived from said selections".

In response to Applicant's prior argument based on the claimed soluble characteristic, the Examiner asserts that this argument is based on molar ratios of the reactants but the claims do not recite any molar ratios.

In response to Applicant's argument based on the claimed steps of the process, the Examiner asserts that this argument is not commensurate in scope with the claims.

Applicants' Response

Applicant has submitted multiple forms of evidence that the prior art DP-PPV compound is **not** soluble and therefore, is not covered by Applicants' claims.

Furthermore, as noted by the Examiner (office action at page 2), the prior art does **not** teach or suggest the benefits of Applicant's claimed soluble compound, including a blue-shift in luminescence.

Finally, the remaining assertions in the last office action are incorrect for the following reasons:

a) Contrary to the Examiner's assertions in paragraph 1 on page 3, the references do **not** teach Applicant's claimed "adjacent substituents". It is these adjacent substituent groups which can make the polymer soluble, whereas DP-PPV has adjacent substituents which do **not** make the polymer soluble. Compare line C (an embodiment of the present invention) with line A (the prior art DP-PPV) in Applicant's diagram submitted November 5, 2002 (copy attached). Furthermore, the reference compounds do **not** have "the claimed characteristics" because Applicant's soluble compounds produce a blue shift in the luminescence, which the Examiner previously admitted distinguishes the prior references. Still further, the required reactants and steps of the processing claim 14 are **not** the same because the method of claim 14 utilizes reactants that produce the different, soluble compound of claim 1, not the insoluble prior art DP-PPV compound.

b) Contrary to the Examiner's assertions in paragraph 2 on page 3, it would **not** be obvious to modify the prior art to select the reactants and the conditions from the references within the limitations of the present claims. Applicant has shown a new result, the blue shift in luminescence. Applicant is not substituting one known compound for another, with the same result. Applicant's different result is not one of degree. Nor is the difference taught or suggested by the art. Instead, the prior art failed to achieve the claimed invention despite extensive commercial activities which establish a long-felt need and failed attempts of others. Thus, the claimed subject matter is **not** rendered obvious.

c) Contrary to the Examiner's assertions in paragraph 3 on page 3, Applicant's claimed soluble characteristic is **not** based on certain molar ratios of the reactants. Applicant's claim a soluble compound which in a disclosed embodiment is based upon the adjacent substituent groups rendering the polymer soluble. In other embodiments a solubilising group is present in a further repeat unit. Patentability does **not** reside in molar ratios used in the reaction, but rather in the soluble nature of the compound itself.

d) Contrary to the Examiner's assertions in paragraph 4 on page 3, Applicant's argument is commensurate in scope with the claims. Claim 14 depends from claim 1 which recites a soluble compound, which for the reasons set forth above can be based upon the particular adjacent substituents, **not** just any adjacent substituents as the Examiner asserts.

As further evidence of the patentable distinction, Applicant submits herewith a declaration of inventor Professor Andrew Holmes. Dr. Holmes obtained a Ph.D. in organic chemistry from the University of London. He is presently a professor of organic and polymer chemistry at the University of Cambridge in the United Kingdom, and a Fellow of the Royal Society. Dr. Holmes has reviewed each of the cited Antonidis, Wan and Hsieh references (Declaration, ¶ 3). He confirms that these documents disclose DP-PPV, which is a derivative of polyphenylene vinylene (PPV) and that PPV is an insoluble polymer, i.e., it is not soluble in any solvent (Declaration, ¶¶ 4-5). He further confirms that in order for a derivative of insoluble PPV to be rendered soluble, the PPV-derivative must have solubilising groups, which enable the polymer to be dissolved and to be solution processable. A solubilising group can be included in a further repeat unit or as a substituent on the phenylene ring of PPV, for example (Declaration, ¶ 6). He further confirms that while DP-PPV has two adjacent phenyl substituents on the phenyl ring of the phenylene vinylene repeat unit, DP-PPV is insoluble which indicates that the phenyl substituents do not aid solubility of this polymer (Declaration, ¶¶ 7-8).

This is yet further evidence confirming the prior evidence submitted by Applicant, that the prior art DP-PPV is an insoluble polymer and thus cannot support a teaching of Applicant's claimed soluble polymer. The prior evidence included (copies attached):

- Hsieh et al., "A New Family of Highly Emissive Soluble Poly(*p*-phenylene vinylene) Derivatives. A Step toward Fully Conjugated Blue-Emitting Poly (*p*-phenylene vinylenes)," *J. Am. Chem. Soc.* 1998, 120 pp. 231-232, submitted with Applicant's supplemental response dated May 27, 2003; this article explicitly refers to the **insoluble** thin film of DP-PPV and its derivatives.

- "Short Lifetimes of Light Emitting Polymers" by Jeffrey Frederick Gold of the University of Cambridge, which may be found on the Internet at www.math.utah.edu/~gold/doc/lep.pdf., submitted with Applicant's response of February 24, 2003; page 3 of this article describes the **insoluble** PPV polymer, which cannot be solution applied to a substrate; this is the same limitation to which the prior art DP-PPV is subject;

- the diagram which Applicant submitted with its response of November 5, 2002; lines A, B, and C illustrate the differences between, an insoluble polymer which can only be applied to a substrate after first preparing a soluble precursor, depositing that precursor on the substrate, and then converting the precursor to the insoluble polymer (line A); in contrast, line B shows that the insoluble polymer **cannot** be solution deposited on a substrate; in further contrast, line C shows that a soluble polymer (of this invention) can be solution deposited on a substrate.

It is imperative that the Examiner understand that a soluble compound must have solubilising groups (e.g., as a substituent on the phenylene ring or as a further repeat unit). As such, the compound recited in present claim 1 and process (of making such a compound) in claim 31 must have solubilising groups, which aid solubility in order to render the compound soluble. Once the Examiner understands this, it is clear this distinguishes the prior art DP-PPV which does not have such solubilising groups (as evidenced in the Declaration by Professor Holmes and other publications). This is a key structural difference between DP-PPV and the soluble compounds according to the

present invention which must have solubilising groups to aid solubility so as to make the compound soluble.

For the sole purpose of clarifying the solubililty feature for the Examiner, Applicant has introduced a new claim 33 which reads:

33. A compound comprising a soluble, film-forming conjugated poly(1,4-arylene vinylene) compound ***having solubilising groups so as to render the conjugated poly(1,4-arylene vinylene) compound soluble*** and having a 1,4-phenylene vinylene unit with adjacent substituents, said substituents being oriented such as to affect the electronic structure of the compound sufficiently to cause a blue-sift in the photoluminescence and/or electroluminescence of the compound.

Support for this new claim 33 may be found from previous claim 1, from page 3 line 9, page 4 second and third lines from bottom of page, and page 8 second full paragraph of the description. Applicant has also introduced a similar new claim 34 based on previous claim 31, which reads:

34. An electric, electronic, optical or optoelectronic component or device having a coating comprising a soluble, film-forming conjugated poly(1,4-arylene vinylene) ***compound having solubilising groups so as to render the conjugated poly(1,4-arylene vinylene) compound soluble*** and having a 1,4-phenylene vinylene unit with adjacent substituents which produces blue-shifted electroluminescence or photoluminescence.

It is submitted that the feature of the compound having solubilising groups is implicit in present claims 1 and 31. This feature simply is recited explicitly in new claims 33 ad 34.

The Examiner previously raised an objection in the Advisory Action that the term "soluble or insoluble...does not mean anything". Specifically, The Examiner asked for clarification of what the compound is soluble or insoluble in. Again, this indicates a lack of understanding of Applicant's prior submissions.

The claimed embodiment of the present invention is not reliant on the compound being soluble in any particular solvent. It is necessary only that there is some solvent that the compound is soluble in. This is important so that films of the compound may be formed by solution processing. This may be contrasted with DP-PPV for which is it not possible to identify a solvent in which the DP-PPV is soluble, so that a film of DP-PPV may not be deposited by solution processing.

In view of the above, it is submitted that the term "soluble" in the present claims has a meaning which is entirely clear in this context.

Furthermore, Applicant notes that the USPTO has accepted similar terms in prior U.S. Patent No. 5,514,878.

Still further, Applicant has introduced new claims 35 and 36 corresponding to claims 1 and 31 and specifying that the compound is soluble in organic solvents. Support for this feature may be found from the second to last line on page 9 and the second to last line on page 4 of the description. These new claims read:

35. A compound comprising a film-forming conjugated poly(1,4-arylene vinylene) compound, ***said poly(1,4-arylene vinylene) compoind being soluble in organic solvents*** and having a 1,4-phenylene vinylene unit with adjacent substituents, said substituents being oriented such as to affect the electronic structure of the compound sufficiently to cause a blue-shift in the photoluminescence and/or electroluminescence of the compound.

36. An electric, electronic, optical or optoelectronic component or device having a coating comprising a film-forming conjugated poly(1,4-arylene vinylene) compound, ***said poly(1,4-arylene vinylene) compound being soluble in organic solvents*** and having a 1,4-phenylene vinylene unit with adjacent substitutents which produces blue-shifted electroluminescence or photoluminescence.

Applicant has also introduced new claims 38 and 39 corresponding to present claims 1 and 31 and which specify that the poly(1,4-arylene vinylene) compound has solubilising groups and that the compound is soluble in organic solvents:

38. (new) A compound comprising a soluble, film-forming conjugated poly(1,4-arylene vinylene) compound having solubilising groups so as to render the conjugated poly(1,4-arylene vinylene) compound soluble in organic solvents, the compound having a 1,4-phenylene vinylene unit with adjacent substituents, said substituents being oriented such as to affect the electronic structure of the compound sufficiently to cause a blue-sift in the photoluminescence and/or electroluminescence of the compound.

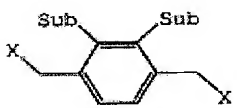
39. (new) An electric, electronic, optical or optoelectronic component or device having a coating comprising film-forming conjugated poly(1,4-arylene vinylene) compound having solubilising groups so as to render the conjugated poly(1,4-arylene vinylene) compound soluble in organic solvents and having a 1,4-phenylene vinylene unit with adjacent substituents which produces blue-shifted electroluminescence or photoluminescence.

Still further, Applicant has submitted the following new process claim 37 which recites:

37. A process for directly obtaining a soluble, film-forming conjugated poly(1,4-arylene vinylene) compound having a 1,4-phenylene vinylene unit with adjacent substituents, said substituents being oriented such as to affect the electronic structure of the compound sufficiently to cause a blue-shift in the photoluminescence and/or electroluminescence of the compound, said process comprising a step of dehydrohalogenation condensation polymerisation comprising subjecting a solution comprising 2,3 disubstituted bishalomethylbenzene monomers to polymerisation with at least two equivalents of base.

Support for new claim 37 may be found from previous claim 31 and from the reference to dehydrohalogenation on the third line from the bottom of page 6 and the third line from the bottom of page 8. Further, support for the compound being "directly obtainable" can be found from page 3 line 10 and page 8, third line from bottom of the description. Applicant notes there must be "at least two" equivalents of base because the specified monomers are bishalo monomers (i.e., they have two reactive end groups)

that will require at least two equivalents of base in order to effect the dehydrohalogenation condensation reaction at both reactive sties so as to polymerise the monomers. This would be readily appreciated by the skilled person. Further support for there being "at least two" equivalents of base can be found from Example 2 on page 11 which discloses six equivalents of base, the last paragraph of page 15 which discloses two equivalents of base, the last paragraph of page 16 which discloses two equivalents of base and also page 17 which discloses 2.2 equivalents of base in the preparation of copolymer 13. Support for the specified monomer can be found from page 8, lines 6-7 of the third full paragraph. This monomer can be represented diagrammatically as:



where 'Sub' represents the adjacent substituents and each X is the same or different and represents a halogen.

This new process claim 37 is consistent with the process diagram previously filed on November 5, 2002 (copy attached), relating to the direct preparation of a compound according to an embodiment of the present invention in a one-step process (line c).

Thus, Applicant respectfully asserts that all of the pending claims 1-7, 9, 11-24, and 30-38 are patentable and in condition for allowance. Reconsideration and allowance is respectfully requested.

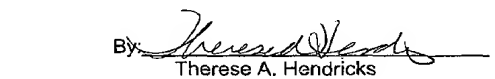
If the Examiner has any further questions, Applicants will schedule time to attend an interview.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

Dated: September 10, 2003

By: 

Therese A. Hendricks
Reg. No. 30,389